classes and superintended the teaching in the laboratories, Dr. Carnelley did not forget that the first duty of a man of science is to advance his subject. That he did so with good effect is seen from the numerous communications of importance contributed to the various learned societies both in this country and in Germany, either alone or in conjunction with other investigators. Prominent amongst the researches with the results of which he has enriched science are those by which he sought to extend the application of Mendeléeff's discovery of the "periodic law," in accordance with which the chemical and physical properties of the elements and of their compounds are periodic functions of the atomic weights of the elements. Carnelley, when a student at the Owens College, appears to have been greatly impressed with Mendeléeff's conceptions, and it was to the study of the physical properties of the elements and their compounds, and to the devising of new methods of obtaining trustworthy determinations of the melting-points of metallic salts and the elements, that he early devoted his energies. The results of these experiments were subsequently utilized to show that the fusibility of the elements and of certain of their compounds is a periodic function of their atomic weights. From the relationships discovered by him to exist between the melting-points of the chlorides of the elements and the atomic weights of those elements Carnelley was led to draw conclusions respecting the atomic weight of the element beryllium and to fix its position in the classification of the elements.

Other physical properties have been shown by Carnelley to be related to the atomic weights of the elements, and in a paper read at the Aberdeen meeting of the British Association he developed a series of analogies between the elements and various series of hydrocarbons, from which he concluded that the chemical elements may be represented by a formula $A_nB_{2n+(2-x)}$, in which n is the series and x the group to which the element belongs; $A = 12$ and $B = -2$. In a paper published in the *Philosophical Magazine* in January last, he tells us that since 1872 he had attempted to give the periodic law a simple numerical expression, and states that early in the summer of 1889 he had obtained such an expression, in which the atomic weight is represented as equivalent to the product of a constant, c, into a factor made up of m, a member of an arithmetical progression, dependent on the series to which the element belongs, and v, the maximum valency, or the number of the group of which the element is a member. Thus—

$$A = c\left(m + v^{\frac{1}{x}}\right).$$

The best results are obtained when $x = 2$, and m is 0 for series II., $2\frac{1}{2}$ for III., 5 for IV., $8\frac{1}{2}$ for V., 12 for VI., $15\frac{1}{2}$ for VII., 19 for IX., $22\frac{1}{2}$ for X., 26 for XI., and $29\frac{1}{2}$ for XII.

The formula thus becomes $A = c(m + \sqrt{v})$, and m is a member of an arithmetical series in which the difference is $3\frac{1}{2}$, save in the first two series, when it is $2\frac{1}{2}$. By using this equation, the value for c in the case of 55 elements is found to lie between 6·0 and 7·2, with a mean value of 6·64. Accepting 6·6 as the value of c, the calculated atomic weight of sodium, for example, would be found as follows:—Sodium is the first member of series III., m is therefore 2·5 and $v = 1$, so that $A = 6{\cdot}6(2{\cdot}5 + \sqrt{1}) = 23{\cdot}1$. In the paper referred to the atomic weights of all the elements are given as calculated by this formula, and compared with those generally accepted. The results obtained exhibit very near approximation, the calculated values being, in fact, nearer the experimental numbers than those obtained by the aid of Dulong and Petit's law. The remarkable coincidence that the value 6·6 for the constant c in the above formula very nearly approximates to the value 6·4, accepted as the atomic heat of the elements, in acccordance with Dulong and Petit's law, is noted, and that the specific heats of the elements may consequently be represented as equivalent to $\frac{1}{m + \sqrt{v}}$. The specific heats calculated by the aid of this formula are compared with the experimental values, and in the case of the 55 elements, in which a comparison can be instituted in 45 instances the agreement is very satisfactory, while the other 10 are elements the specific heats of which, according to Dulong and Petit's law, are more or less abnormal.

Accepting Bettone's conclusion that the hardness of an element is inversely proportional to its specific volume, it is shown that hardness may be represented in terms of the specific gravity, and the expression $6{\cdot}6(m + \sqrt{v})$, thus—

$$\text{Hardness} = \frac{1}{\text{spec. vol.}} = \frac{\text{sp. gr.}}{\text{at. wt.}} = \frac{\text{sp. gr.}}{6{\cdot}6(m + \sqrt{v})}.$$

But Carnelley's energies were not alone given to the investigation of questions of a purely scientific interest, for, naturally, one situated as he was all his life in the midst of active industrial communities found many opportunities of applying his knowledge and training for the benefit of those around him. Notably was this the case in the valuable examinations, chemical and bacteriological, of the air of dwellings, schools, &c., in Dundee and district, in a report to the School Board, of which he was an active member. Much valuable information was brought to light by these investigations, and it would appear that one result attained was the realization by the authorities in Dundee, Aberdeen, and some other towns, of the necessity of making provision in schools for the supply of a pure aërial food for the scholars. This subject—the ventilation and heating of schools, &c.—was, we believe, one with which he was busily engaged at the time of his last illness, and it is to be hoped that the labour which he expended upon it will be continued by one of his competent collaborateurs.

Prof. Carnelley was also the author of an elaborate and most valuable compilation of certain physical constants of chemical compounds, published in two large volumes, a monument of industry and devotion to science; he was, moreover, an extensive contributor to the German-English dictionary of scientific and technical terms published by Messrs. Vieweg and Son, of Brunswick.

Of a retiring, modest, unselfish, and deeply religious nature, his earnest enthusiasm served not only to create in all a sincere regard for him, but to make him beloved by those who were privileged, whether as teachers or students, to become intimately acquainted with him. At all times an ardent student, an untiring investigator, a successful teacher, and a contributor in so great a variety of ways to the advancement of science, by his early death an already brilliant career has been deplorably cut short and a vacancy created in the ranks of scientific men in this country which must long remain unfilled.

H. E. R.
P. P. B.

NOTES.

THE well-known writer on vegetable palæontology, Prof. E. Weiss, of Berlin, died on July 5 last.

THE Swedish residents of Chicago have subscribed for a statue of Linnæus, which will shortly be erected in the Lincoln Park in that city.

DR. A. MÖLLER, of Berlin, has established, at Blumenau in the State of S. Catharina in South Brazil, with the assistance of the Prussian Academy of Sciences, a botanical laboratory, where, during the next two years, he will pursue Brefeld's method of the artificial culture of the higher and lower filamentous Fungi. He will be glad to receive suggestions from botanists interested in the subject

The Congress of the United States has granted the sum of 40,000 dollars, to be employed, exclusively of salaries, in the prosecution of botanical work by the Division of Botany of the Department of Agriculture. The Section of Vegetable Pathology has now been made a distinct division, and is at present especially concerned in investigating the grape-vine disease which is spreading rapidly in California.

There has recently been added to the marine collection at the Brighton Aquarium a specimen of the manatee, or "sea cow." The specimen has been imported from Trinidad, and was brought from Liverpool by Mr. Wells, the marine superintendent, under whose careful supervision it was safely transferred to its new home in the Brighton Aquarium. The tank in which it has been placed has been specially fitted with heating apparatus, it being necessary to keep the temperature to between 70° and 80°. The manatee is 4 feet 6 inches in length, and feeds principally upon lettuce, of which it consumes large quantities.

The Lords of the Committee of Council on Education have just sanctioned under Clause 8 of the Technical Instruction Act, 1889, a resolution passed on August 12, 1890, by the Council of the city of Worcester. This resolution consisted in making grants, under the powers conferred upon them by the Act, to certain institutions in Worcester for the promotion of technical instruction, and it was the opinion of the Council that such a form of instruction is required by the circumstances of the district. The instruction is to be given in the following subjects, which are not included in the branches already recognized by the Science and Art Department: French, German, typewriting, shorthand, bookkeeping, commercial geography, commercial arithmetic, and cookery.

The *Photographic News* contains an account of the eleventh annual Convention of the Photographers' Association of America, which proved a great success. The chief part of the programme was the unveiling of the monument to Daguerre at the city of Washington. The work was after the design of Scott Hartley, and is stated to be of a beautiful unique design, and worthy of the admiration of every photographer in America. The sessions, owing to the kindness of the United States officials, were held in the National Museum, and under the very able management of the executive officers an excellent programme was provided and carried out successfully. There was an unusually large number of papers presented, and the discussions were entered into by the members in the most hearty and satisfactory manner. Among other articles are those by Dr. H. W. Vogel on photography in Germany, and by Colonel J. Waterhouse on the reversal of the negative photographic image by thio-carbamides.

The last two numbers of *Cosmos* contain some very interesting information on various topics. Some new discoveries have been made at Pompeii, near the Stabiana Gate, and a description is given of them. Three bodies were found, two being those of men and the third that of a woman. Not far from the resting place of these bodies was found the trunk of a tree, 3 metres in height, and measuring 40 centimetres in diameter. This tree, together with its fruits that were found with it, have been examined by the Professor of Botany, M. Pasquale, who finds in it a variety of *Laurus nobilis*. By means of the fruits, since they come to maturity in the autumn, he concludes that the eruption did not take place in August but in November.

The current number of *La Nature* contains an interesting account of the ceremony of unveiling the new statue of Gay-Lussac at Limoges. In the name of the Academy of Sciences, M. P. P. Dehérain gave a long discourse on the life and works of this great man, extracts from which are given. Prince Roland Bonaparte gives a description of the race of Somalis, some of which are at present in the Acclimatization Gardens of Paris, and which form a most curious ethnographical exhibition. The article is written from observations of the author and from other sources, and deals with the country, food, habits, dress, &c., of these people who inhabit that country, "si affreux et si désolé."

It was observed a short time ago by Dr. Kremser, that the curve of mortality in North Germany lagged about two months behind that of the variability of temperature. An inquiry into this matter in the case of Budapesth has been lately made by Dr. Hegyfoky, taking the nine years 1873-81. Comparing the months, he failed to make out a certain connection. But taking into account other meteorological elements besides temperature, and reckoning by seasons, he found the variability of weather in the different seasons to give the following order from maximum to minimum: winter, spring, autumn, summer. As regards mortality, the order was: spring, summer, winter, autumn. Thus it appears there is a displacement of three months. If a connection of the kind referred to really exists between weather and mortality, the effect, mortality, must appear somewhat later than the cause, variation of weather.

The *National Review* for September contains an article on the progress of weather study, by H. Harries. The subject dealt with refers chiefly to the wind, and the author traces the history of the development of the law of storms and of the practical application to weather prediction. He points to the useful work of the Meteorological Department under Admiral FitzRoy in collecting synchronous observations of the *Royal Charter* storm of October 1859. The charts then published, although too limited in their area, threw much light on the movements of the atmosphere and formed a most important step in the right direction. The later investigations of the Meteorological Council of the United States Office, and of the *Deutsche Seewarte*, &c., have contributed greatly to increase our knowledge, and to improve the accuracy of weather forecasts and it is by such synchronous discussions, and by taking advantage of the reports from rapid steam vessels, that we must hope for an extension of our knowledge in the future.

Mr. E. Nevill, the Government Chemist at Natal, in his last report to the Colonial Secretary, notes that valuable deposits of argentiferous galeno of copper and of bismuth exist in the colony, and of such rich nature that they could be profitably exported in bulk. In both Alexandra and Umvoti Counties deposits of silver-bearing lead ore have been found, containing from ten to fifteen pounds worth of silver per ton of lead ore. Saltpetre has been found so rich as to be worth more than three times as much as the best Peruvian deposits. Plumbago, asbestos, and the mineral phosphates appear to be of inferior quality. Several calcareous formations have been examined, which are likely, under proper treatment, to yield good hydraulic cement.

Some chemical reactions can be started or accelerated by sunlight, and an increased effect is to be expected where the rays are concentrated by a lens or concave mirror. Herr Brühl has recently described (in the *Berichte*) experiments made in this way, in production of zinc ethyl from zinc and ethyl iodide (a reaction difficult to start). The retort, containing zinc-filings and several hundred grammes of ethyl iodide, was placed at the focus of a concave mirror, about a foot in diameter, receiving the sun's rays. The reaction soon began, and grew so vigorous that cooling was necessary. In a quarter of an hour all the ethyl iodide was consumed, and through the subsequent distillation in an oil-bath, a good yield of zinc ethyl was had. This radiation process, it is suggested, might be variously useful in actions on halogen-compounds, which tend to be disaggregated by sunlight. A lens, owing to the athermanous property of glass, would be less powerful.

MR. A. MCADIE, Fellow of Clark University, U.S., has forwarded us his prize essay on tornadoes, reprinted from the *American Meteorological Journal* for August. After a discussion of the state of our knowledge of storms of this character, the possibility and practicability of predicting them is considered. It is suggested that, since the barometric movement is too sluggish and the thermometric indications too much masked to be serviceable, the electrometer might be better adapted to give notice and warning of the proximity of violent whirlings in the air and detect those which would otherwise pass unheeded. A careful study of cloud movement is also suggested, as a method promising much in the way of obtaining knowledge bearing on the occurrence of tornadoes.

THE Report of Dr. Eitel, Inspector of Schools in Hong Kong, for the past year, contains some interesting details. The total number of educational institutions of all descriptions, known to have been at work in the colony of Hong Kong during the year 1889, amounts to 211 schools, with a grand total of 9681 scholars under instruction. More than three-fourths of the whole number of scholars, viz. 7659, attended schools (106 in number) subject to Government supervision, and either established or aided by the Government. The remainder, with 2022 scholars, are private institutions, entirely independent of Government supervision and receiving no aid from public funds. The total number of schools subject to direct supervision and annual examination by the Inspector of Schools amounted, in 1889, to 104, as compared with 50 in 1879, and 19 in 1869. The total number of scholars enrolled in this same class of schools during 1889 amounted to 7107, as compared with 3460 in 1879, and 942 in 1869. In other words, there has been an increase of 31 schools and 2518 scholars during the ten years from 1869 to 1879, and an increase of 54 schools and 3647 scholars during the ten years from 1879 to 1889. It would seem, therefore, that the decennial increase of schools and scholars during the last twenty years has shown a tendency to keep up with the progressive increase of population. Comparing the statistics of individual years, the number of schools under supervision and examination by the Inspector of Schools rose from 94 in 1887 and 97 in 1888 to 104 in 1889, whilst the number of scholars under instruction in these same schools rose from 5974 in 1887 and 6258 in 1888 to 7107 in 1889. There is, therefore, a steady annual increase during the last three years, progressing from an increase of 284 scholars in 1888 to an increase of 849 in 1889. The expenses incurred by the Government during the year 1889, on account of education in general, amounted, exclusive of the cost of new school buildings, to a total of $53,901.

IN *Science* reference is made to a question which may interest many of our readers, "Should beer be drunk out of a glass?" Dr. Schultze claims to have established, by a very extended series of experiments, that beer, by as little as five minutes' standing in any glass, even when cold and in the dark, will be materially affected both in taste and odour. By making trial tests on some one hundred persons he sustains his claims. The change is due, as he thinks, to the slight solubility of the glass substance in the beer. Lead is used in the manufacture of glass, making it more easy to manipulate, and from experiments with glass obtained from the leading sources of supply, he determined that one cubic centimetre of beer, by five minutes' standing in glass, dissolved 6–26 ten-millionths of a milligram of the glass substance containg 0–48 thousand-millionths of a milligram of lead oxide. It is this small quantity of glass substance that affects the taste of the beer, and if it contains lead, renders it objectionable for sanitary reasons. By further experiments with vessels of different substances, he comes to the conclusion that gold-lined silver mugs are the best, and he ranks covered salt-glazed stone mugs as good.

THE United States Consul at Hanover, in a recent report refers to afforestation in that State, where, he says, there were formerly rich tracts of forests. These, in consequence of wars, were reduced to desolate wastes, and remained so until the first decades of the present century—particularly those districts between Hamburg and Hanover which are known by the name of Luneburger Haide. Another reason for the devastation was mismanagement, such as division of common forests, by which they were dispersed and fell into the hands of people with small means, and thus were doomed to neglect and destruction. The celebrated Burkhardt was appointed Director of the Forest Department in 1850, and under him part of the Luneburger Haide, as well as other tracts growing more and more desert by the encroachments of sand, have been wooded with great pains and trouble. To prevent the increase of sandy deserts those tracts were at first planted with fir-trees. After a number of years these were cleared, and beech and other trees substituted. How much the forests have been enlarged in this manner will appear by the fact that the wooded surface amounted in the year 1850 to 1,217,625 acres, and in 1885 to 1,551,900 acres. The Government granted large sums for the purchase of land unfit for cultivation to be turned into forest tracts, and is now intent on uniting again those formerly scattered wooded parts into one single tract. In the same way the Klosterkammer (Administration of cloister funds) purchase extensive stretches of soil. Municipalities, communities, and even private individuals who are inclined to establish forests and manage them rationally, will receive loans at 2 per cent. from the Provincial Government, to be reimbursed yearly by small instalments; single subsidies also are granted for converting large wastes into forest grounds. The Government employed vagabonds, tramps, and prisoners not of a dangerous character, for forest culture. In this manner about 9000 acres were planted with trees by those troublesome classes within the years 1876 to 1888. Moreover, communities as well as private individuals have turned about 14,000 acres into forest grounds within the same period by means of subsidies afforded by the Provincial Government, and various towns have laboured to preserve and plant forests in their vicinity for purposes of health, recreation, and incidentally of profit also.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. A. S. Keys; a Brazilian Tree-Porcupine (*Sphingurus prehensilis*) from Trinidad, presented by Mr. J. N. Kilner; two Vulpine Phalangers (*Phalangista vulpina* ♂ ♀) from Australia, presented by Mr. J. G. Mackie; two Pucheran's Guinea Fowls (*Numida pucherani*) from East Africa, presented by Mr. Keith Anstruther; a Silver Pheasant (*Euplocamus nycthemerus* ♀) from China, presented by Mr. E. W. H. Blagg; two Wheatears (*Saxicola œnanthe*), a Stonechat (*Pratincola rubicola*), a Whitethroat (*Sylvia cinerea*), British, presented by Mr. J. Young, F.Z.S.; an Owen's Apteryx (*Apteryx oweni*) from New Zealand, presented by Capt. E. A. Findlay, R.N.R., R.M.S. *Ruapehu*; a Blue and Yellow Macaw (*Ara ararauna*) from South America, presented by Mr. Luxmore Marshall; a Blue-eyed Cockatoo (*Cacatua ophthalmica*) from New Britain, presented by Mrs. R. E. Anson; a Guillemot (*Lomvia troile*), British, presented by Mrs. Forbes; two Common Gulls (*Larus canus*), a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. A. C. Howard; a Lion (*Felis leo* ♂) from Sokoto, West Africa, deposited; a Common Bee-eater (*Merops apiaster*), European, a Green-headed Tanager (*Calliste tricolor*) from Brazil, purchased; three Garden Dormice (*Myoxus quercinus*) from Vosges, France, received in exchange; two Viscachas (*Lagostomus trichodactylus*), born in the Gardens.